



ART. XV.—*A Contribution to the Petrology of Kerguelen Island.*

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[Read 8th December, 1895.]

The rocks described in the following paper were collected by Mr. Robert Hall of Surrey Hills, Melbourne, who visited Kerguelen Island in a whaling vessel in January, 1898. They were obtained from four localities, namely, Howe Island, Greenland Harbour, Royal Sound, and "Cat's Ears." Rocks from the three first-named places have been described either by Professor J. Roth,<sup>1</sup> or by Professor A. Renard.<sup>2</sup> Under these circumstances only brief references will be made to rocks and localities which have been previously dealt with. Though no information can be given by the writer as to the field relations of the rocks described below, the specimens brought by Mr. Hall may help to supplement the lengthy account of the petrology of Kerguelen Island given by Professors Roth and Renard.

*Howe Island.* Two rocks—a basalt and a phonolite—were taken from this Island. The basalt is bluish-black in colour, and very fine-grained in texture, olivine is the only mineral which can be detected by the naked eye. Under the microscope the slide appears almost entirely opaque owing to the dissemination of magnetite dust through the matrix. Plagioclase felspar, micro-liths of felspar, augite and olivine—the last-named often much serpentinized—can be observed.

The occurrence of phonolite on this island does not appear to have been previously noticed. On the weathered surface of the specimen crystals of felspar and augite stand out; the rock breaks with a somewhat even fracture, and felspar and augite are plainly seen embedded in a dark grey matrix of fine-grained texture. The base is micro-granular, composed of grains and

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<sup>1</sup> J. Roth. Ueber die Gesteine von Kergueland. Monatsber. d.k. preuss. Akad. d. Wiss. Berlin. 1875, pp. 723-735.

<sup>2</sup> A. Renard. The Rocks of Kerguelen Island. Narr. Chall. Exp., vol. ii., pp. 107-141.

laths of felspar and augite. In this are set crystals of sanidine, augite, hornblende, and nepheline. The other minerals present are apatite and sphene, with mica and grains of magnetite of secondary origin. The sanidine occurs in tabular crystals, often showing Carlsbad twinning with characteristic broken line of penetration. Augite is present in large crystals with eroded edges and dark zonal border, and also in groups or bunches of small crystals with somewhat ill-defined boundaries. Hornblende has undergone considerable modification by magmatic secretion; the crystal form is as a rule well-preserved, but a dark zonal border has in some cases been formed, leaving an internal portion showing marked pleochroism, while in others the entire crystal has been replaced. Nepheline is present in considerable quantity, it occurs for the most part in microscopic forms giving quadratic and hexagonal sections, but there are a few crystals of large size visible. The other minerals in the slide do not call for any detailed notice.

An analysis of this rock kindly made for me by Messrs. W. H. Green, B.Sc., and B. D. Steele, B.Sc., yielded the following result:—

Si O <sub>2</sub>	- - =	53·87	Ca O	- - =	2·13
Ti O <sub>2</sub>	- - =	1·10	Mg O	- - =	0·34
P <sub>2</sub> O <sub>5</sub>	- - =	0·18	K <sub>2</sub> O	- - =	6·24
Al <sub>2</sub> O <sub>3</sub>	- - =	20·64	Na <sub>2</sub> O	- - =	6·86
Fe <sub>2</sub> O <sub>3</sub>	- - =	4·51	Loss on ignition	=	2·93
Fe O	- - =	1·42			
Mn O	traces				102·22

Twenty-eight per cent. of the rock is soluble in strong HCl.

This analysis completes the determination of the rock as a phonolite; it is in close agreement with that of a phonolite from Greenland Harbour given at page 134 of the Challenger volume.

*Greenland Harbour.*—The single specimen from this place is an augite-olivine rock approaching in type a limburgite. It has a micro-granular base composed of grains of augite and magnetite, with a small quantity of lath-shaped felspar microliths. No phenocrysts of felspar occur; the olivine crystals are numerous, of large size, and have undergone much serpentinization; there are traces of secondary zeolitic matter.

*Royal Sound.*—Two specimens come from this place. One is a fine-grained dark coloured rock, breaking with a sub-concoidal fracture. The slices prepared from it show an entirely opaque base, in which crystals of hornblende, augite and apatite can be seen. No traces of felspar can be detected. In many cases the interior of a crystal has been entirely replaced by magnetite, while a bordering zone of translucent material showing weak polarisation tints has been formed round the altered crystal. The other specimen is a small rounded pebble of grey colour and fine-grained texture. There are certain markings on the external surface which simulate the appearance of a fossil, but on examination they are seen to be due to zeolitic matter. Under the microscope the rock is found to be made up of grains of augite pseudomorphic after hornblende, wedged in between lath-shaped interlacing felspars twinned according to the Carlsbad law. These felspars present the typical "trachyte" structure; they have a certain linear disposition and show a tendency to flow structure around the phenocrysts of felspar and augite, which they enclose. The character of the felspars points to sanidine, but the amount of alteration which the rock has undergone makes exact determination difficult. I am inclined to class the rock as an augitic trachyte, specimens of which are described from other parts of Kerguelen Island.

*"Cat's Ears."*—The rocks from this locality are the most important collected by Mr. Hall. Though a description of the hill at the south-west entrance to Royal Sound, known as "Cat's Ears," is given in the Challenger volume, no rocks from the hill were submitted to Professor Renard for examination. Seven specimens—suitable for slicing—were brought back by Mr. Hall, and form an interesting series.

1. A somewhat decomposed vesicular lava in which triclinic felspar, augite, magnetite and altered olivine occur in a glassy base.

2. A decomposed rock in which the minerals which can be determined with certainty are plagioclase felspar—in minute lath-shaped crystals—augite and magnetite. There is a considerable amount of glass present, and in it are numerous colourless acicular crystals of what is probably apatite.

3. A basalt containing much glass, triclinic felspar—showing both albite and pericline twinning—augite and magnetite. The felspar occurs both as phenocrysts and microliths: the augite is present only in grains.

4. A coarse-grained holocrystalline olivine basalt rich in triclinic felspar; augite occurs both as grains and phenocrysts, the latter being sometimes twinned. The slide shows traces of ophitic structure; olivine has been almost entirely serpentinized; magnetite is also present.

5. A volcanic ash with schistose structure. Angular fragments of quartz, plagioclase felspar and augite can be seen, but alteration of the rock renders further determination impossible.

6. A fine grained rock of bluish-black colour, in which felspar and hornblende can be seen. The base is composed of crystals of nepheline, lath-shaped felspars and grains of augite. Sanidine occurs in pellucid crystals of tabular habit and showing Carlsbad twinning. Alteration of the crystal has taken place either by the deposition of opaque specks along the partings, or by infiltration into cracks of silicious matter with high polarisation tints. There is much hornblende, but it has been a good deal modified. Around the larger crystals a deep coloured zonal border has been formed, leaving a strongly pleochroic interior. The smaller crystals have become entirely opaque by the same resorbing action of the magma as that which produced the zonal border in the larger crystals. At the same time, the alteration of the hornblende has been accompanied by the formation of minute irregular grains of augite which surround the hornblende crystals and give them a frayed appearance. Augite also occurs as phenocrysts, but with ill-defined crystal edges. Nepheline is well represented in the slide in microscopic crystals, giving quadratic and hexagonal sections. Apatite occurs in rather long prismatic crystals, and is frequently seen as an inclusion in the hornblende. There is some sphene present and epidote occurs as an alteration product of hornblende. The rock should be classed as a hornblende phonolite.

7. A somewhat decomposed rock of light grey colour, in which felspar and hornblende are visible. There is some glass present in the base, also magnetite, augite grains and microliths of felspar.

The prevailing felspar is sanidine, which occurs in rather large crystals. It is modified just as in the rock No. 6. Hornblende is in considerable quantity, and it has undergone a modification similar to that in the rock just described. Augite is sparingly distributed. Apatite and sphene occur. There are a few altered crystals present which from their sections suggest nepheline; alteration has, however, taken place to such an extent as to make the microscopic determination of this mineral uncertain. In addition to secondary zeolitic matter, there is also some secondary silicious matter filling cracks and cavities in the slide; when visible in cavities it has a radially fibrous structure. The rock may possibly be an altered phonolite.